2007 Federal Recovery Outline

Southern Oregon/Northern California Coast Coho Salmon

Prepared by

The National Marine Fisheries Service

Southwest Region, Arcata Area Office

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DISCLAIMER

This recovery outline is meant to serve as an interim guidance document to outline recovery efforts, including recovery planning, for the Southern Oregon/Northern California Coast coho salmon Evolutionarily Significant Unit, until a full recovery plan is developed and approved. A preliminary strategy for recovery of the species is presented here, as are recommended high priority actions to stabilize and recover the species. The recovery outline is intended primarily for internal use by the National Marine Fisheries Service (NMFS) as a pre-planning document. Formal public participation will be invited upon the release of the draft recovery plan for the species. However, any new information or comments that members of the public may wish to offer as a result of this recovery outline will be taken into consideration during the recovery planning process. Recovery planning has been initiated and a recovery plan is targeted for completion in 2008. NMFS invites public participation in the planning process. Interested parties may contact the Southern Oregon/Northern California Coast Recovery Domain Coordinator, Greg Bryant, at 1655 Heindon Road, Arcata, California 95521 or via e-mail at greg.bryant@noaa.gov.

I. PURPOSE AND OVERVIEW

This Recovery Outline has been developed to guide the recovery planning process for the Southern Oregon Northern California Coast (SONCC) coho salmon (*Oncorhynchus kisutch*) Evolutionarily Significant Unit (ESU), listed as threatened under the Federal Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. § 1531 *et seq.*).

The NMFS Southwest Region (SWR) Protected Resources Division (PRD) in Arcata, California, is responsible for the development of a recovery plan for the SONCC ESU. The NMFS Strategic Plan for 2005 establishes a high priority focus on recovery plan development over the next five years. The SWR, in coordination with the Northwest Region, will proceed with recovery planning by developing a draft recovery plan for this ESU in 2008.

The ESA requires the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) to develop and implement recovery plans for the conservation and survival of NMFS' listed species. According to the NMFS Interim Recovery Planning Guidance (NMFS 2006):

> Recovery is the process by which listed species and their ecosystems are restored and their future safeguarded to the point that protections under the Federal ESA are no longer needed. A variety of actions may be necessary to achieve the goal of recovery, such as the ecological restoration of habitat or implementation of conservation measures with stakeholders. However, without a plan to organize, coordinate and prioritize the many possible recovery actions, the effort may be inefficient or even ineffective. The recovery plan serves as a road map for species recovery – it lays out where we need to go and how best to get there. According to the ESA 4(f), recovery plans must contain: (1) objective measurable criteria for delisting the species; (2) site-specific actions; and (3) estimates of the time and cost for implementing the recovery plan.

Recovery plans are guidance documents, not regulatory documents. However, the ESA clearly envisions recovery plans as the central organizing tool for guiding the recovery process for each species. They should also guide Federal agencies in fulfilling their obligations under Section 7(a)(1) of the ESA, which calls on all Federal agencies to "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species…" In addition to outlining proactive measures to achieve the species' recovery, recovery plans provide context and a framework for implementation of other provisions of the ESA with respect to a particular species, such as Section 7(a)(2) consultations on Federal agency activities, or the development of Habitat Conservation Plans in accordance with Section 10(a)(1)(B) of the ESA.

In the interim between listing and recovery plan approval, NMFS Interim Recovery Planning Guidance requires the development of a Recovery Outline for listed species (NMFS 2006). A Recovery Outline provides a preliminary strategy for conservation of the listed species that conforms to the mandates of the ESA. The Recovery Outline is intended to guide initial recovery actions and ensure that future recovery options are not precluded due to a lack of interim guidance. Recovery actions that are identified at the time the species is listed, as well as actions that constitute the initial steps of long-term recovery efforts, can be implemented more effectively and efficiently when they reflect integral parts of a comprehensive recovery strategy. By providing a consistent and concise view of the species' status, current and anticipated threats, and recovery needs, the Recovery Outline can also provide a basis for analyzing effects of individual projects under ESA Sections 7, 10 and 4(d) programs. It can also be used by biologists and resource managers to assist project proponents to avoid narrowing or precluding future recovery options, such as the loss of a portion of the habitat that might later be determined to be important to the recovery of the species. Allendorf *et al.* (1997) provide a general discussion of prioritizing Pacific salmon stocks for conservation. For the SONCC coho salmon ESU, Williams *et al.* (2006) present a historic population structure for the ESU and Williams *et al. (in prep.)* discuss requirements for viable populations across the ESU.

II. GENERAL INFORMATION

A. Species Name, Listing Status and Contacts

The Southern Oregon/Northern California Coast coho salmon (*Oncorhynchus kisutch*) ESU was listed as Threatened on May 6, 1997 (62 FR 24588). This status was reaffirmed in a Final Rule published on June 28, 2005 (70 FR 37160). The NMFS Arcata Area Office serves as the lead office for all recovery planning efforts related to the Southern Oregon/Northern California Coast Recovery Domain:

Greg Bryant
SONCC Domain Recovery Coordinator
National Marine Fisheries Service
1655 Heindon Road
Arcata, California, 95521

B. Species Range

The SONCC coho salmon ESU includes all naturally spawned populations of coho salmon in coastal streams from the Elk River near Cape Blanco, Oregon, through and including the Mattole River near Punta Gorda, California (62 FR 24588; May 6, 1997). Major rivers in the ESU include the Rogue, Klamath-Trinity and Eel. Figure 1 lists the major watersheds contained in the ESU.

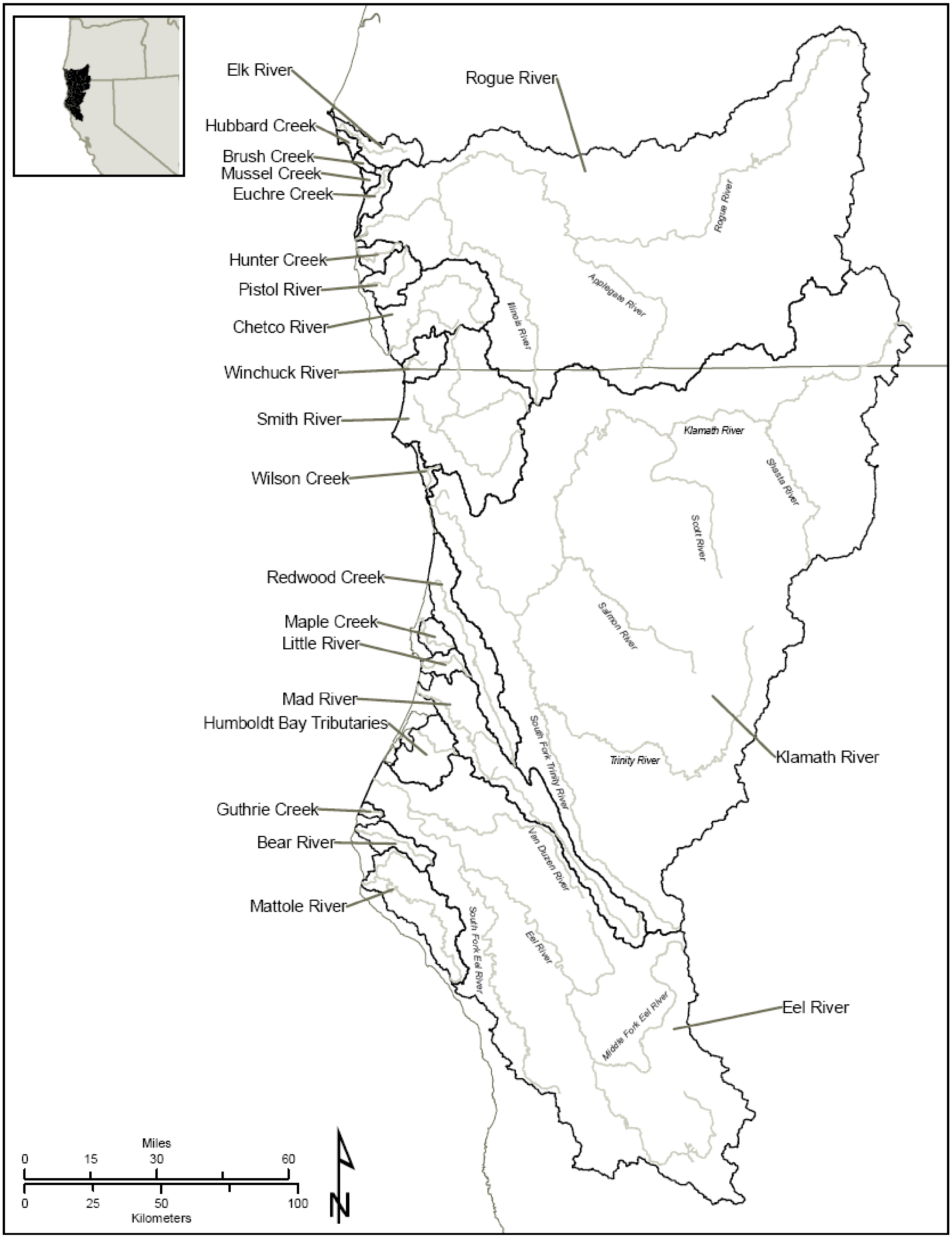


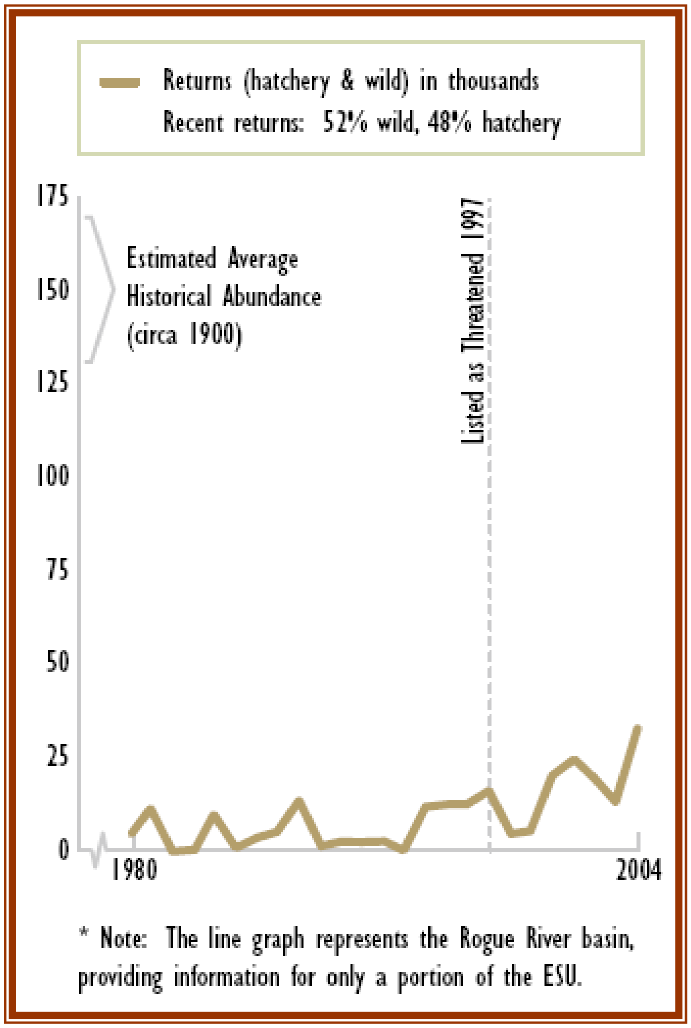
Figure 1. Major watersheds in the SONCC ESU. Figure from Williams *et al.* (2006).

III. RECOVERY STATUS ASSESSMENT

A. Biological Assessment

In 1995, NMFS' Biological Review Team (BRT) conducted the first comprehensive status review of coho salmon from Washington, Oregon, and California and identified the SONCC coho salmon ESU as one of six coho salmon ESUs along the United States Pacific Coast (Weitkamp *et al.* 1995). In July 1995, NMFS published a proposed rule to list under the ESA the SONCC coho salmon ESU as threatened, which is defined in the ESA as "likely to become endangered within the foreseeable future throughout all or a significant portion of its range" (60 FR 38011; July 25, 1995). In 1997, the BRT updated the SONCC coho salmon risk assessment and concluded that the SONCC coho salmon ESU is "likely to become endangered within the foreseeable future" (NMFS 1997). NMFS published a final rule listing the SONCC coho salmon ESU under the ESA as "likely to become endangered within the foreseeable future throughout all or a significant portion of its range" (62 FR 24588; May 6, 1997). In 2003, the BRT again updated the risk assessment for the SONCC coho salmon ESU and again concluded that the naturally spawned component of the ESU is "likely to become endangered within the foreseeable future" (NMFS 2003). In reaching this finding, the BRT determined that the Viable Salmonid Population (VSP) parameter risks (McElhany *et al.* 2000) for the SONCC coho salmon ESU were "moderately high" (NMFS 2003).

The only reliable time series of adult abundance for the naturally spawning component of the SONCC coho salmon ESU is for the Rogue River population in southern Oregon (Figure 2). The California portion of the ESU is characterized by a paucity of data, with only a few available spawner indices and presence-absence surveys. The recent 5-year mean abundance for the Rogue River is approximately 5,000 natural spawners and is the highest such abundance for the Rogue River data series (since 1980). The BRT concluded, based on an analysis of pre-harvest abundance, however, that these positive trends for the Rogue River population reflect the effects of reduced harvest rather than improved freshwater conditions and population productivity (NMFS 2003).



FFigure 2. Rogue River Basin coho salmon returns (hatchery and wild) from 1980-2004. From NMFS (2007).

Less reliable indices of spawner abundance in several California populations suggest flat or declining trends (Figure 3). Relatively low levels of observed presence in historically occupied coho salmon streams (32-56 percent occupancy rate from 1986 to 2000) indicate continued low abundance in the California portion of this ESU. Although extant populations reside in all major river basins within the ESU, the BRT was concerned about the loss of local populations in the Trinity, Klamath, and Rogue River systems (Weitkamp *et al.* 1995; NMFS 1997, 2003). The high hatchery production in these systems may mask trends in ESU population structure and pose risks to ESU diversity. The recent termination of out-of-basin transfers in California is expected to result in decreased risks to ESU diversity. The BRT found moderately high risks for abundance and productivity VSP categories, with comparatively lower risk for spatial structure and diversity (NMFS 1997, 2003).

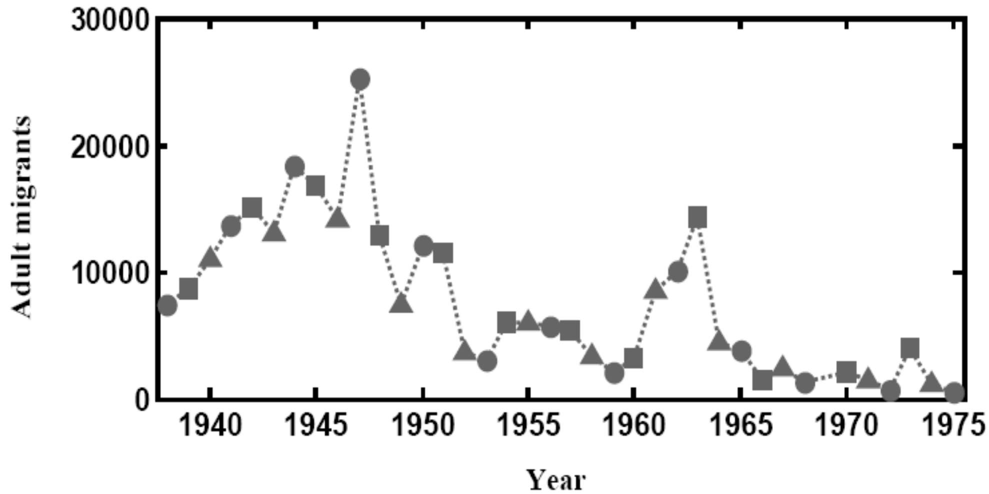


Figure 3. Although long-term trends in abundance data are rare, particularly for California streams, available data suggest a decline in abundance such as this example of adult coho salmon counts at Benbow Dam on the South Fork of the Eel River. Adult counts ceased in the 1970s, leaving more recent trends in abundance uncertain, except for changes in occupancy rates discussed in NMFS status reviews which suggest continued low abundance. Figure from Spence 2001.

Most recently, Good *et al.* (2005) reviewed updated presence-absence analyses, new indices of spawner abundance in the Smith, Mad and Eel River basins, and substantially expanded monitoring programs in southern Oregon. They noted that none of these data contradicted earlier conclusions reached by the BRT. Also, none of the updated data sets suggested any marked change, either positive or negative, in the abundance or distribution of coho salmon within the SONCC coho salmon ESU. They noted that previous observations of severe declines from historical run sizes, the apparent frequency of local extinctions, long-term trends that are clearly downward, and degraded freshwater habitat and associated reduction in carrying capacity continue to be of concern.

B. Historic Population Structure

The Technical Recovery Team (TRT) for the SONCC Recovery Domain has adopted a population classification scheme that extends the concept of an "independent population" to consider the place of each population with respect to expected viability-in-isolation and self-recruitment (Williams *et al.* 2006). Viability-in-isolation is assessed as a function of population size (measured as a habitat-based proxy for historical carrying capacity). Self-recruitment is a measure of the degree to which a population's dynamics are influenced by immigration, and is a function of the size of a population, the size of potential donor populations and the distance between populations. These measures allow the TRT to define four population classes:

- "Functionally Independent Populations" are those with a high likelihood of persisting in isolation over a 100-year time scale.
- "Potentially Independent Populations" have a high likelihood of persisting in isolation over a 100-year time scale, but are too strongly influenced by immigration from other populations to exhibit independent dynamics.
- "Dependent Populations" have a substantial likelihood of going extinct within a 100-year time period in isolation, yet receive sufficient immigration to alter their dynamics and extinction risk, and presumably increase persistence or occupancy.
- "Ephemeral Populations" have a substantial likelihood of going extinct within a 100-year time period in isolation, and do not receive sufficient immigration to affect this likelihood. Habitats that support such populations are expected to be occupied only for relatively short periods of time, and rarely at high densities.

Evaluating absolute extinction probabilities or the specific level of immigration at which extinction risks are strongly affected is difficult and fraught with uncertainty. Therefore, in practice, analysis of population structure focuses on ranking populations along these two axes, and identifying thresholds for viability-in-isolation and self-recruitment that are both readily interpretable and robust to changes in parameter values in the underlying models. Within larger basins, the physical distribution of spawning and rearing habitats and evidence of strong environmental differences among sub-basins are also considered to determine whether a large basin harbors multiple historical populations.

Table 1 and Figure 4 summarize the TRT's conclusions regarding the historical population structure of the SONCC coho salmon ESU. The Rogue, Klamath, and Eel Rivers are major components of this ESU. Coho salmon in other basins in the Recovery Domain existed as functionally independent populations under historical conditions (*e.g.*, Elk River, Smith River, Redwood Creek, Humboldt Bay tributaries, Mattole River). A few populations that were sufficiently large to have been viable-in-isolation are nevertheless strongly influenced by immigration from larger populations near by, and are considered potentially independent (*e.g.*, Winchuck River, Little River).

Populations are aggregated into major groupings depending on their location (inland versus coastal) as well as their north-to-south occurrence (*i.e.*, northern coastal major population group, southern inland major population group, etc.; Table 1).

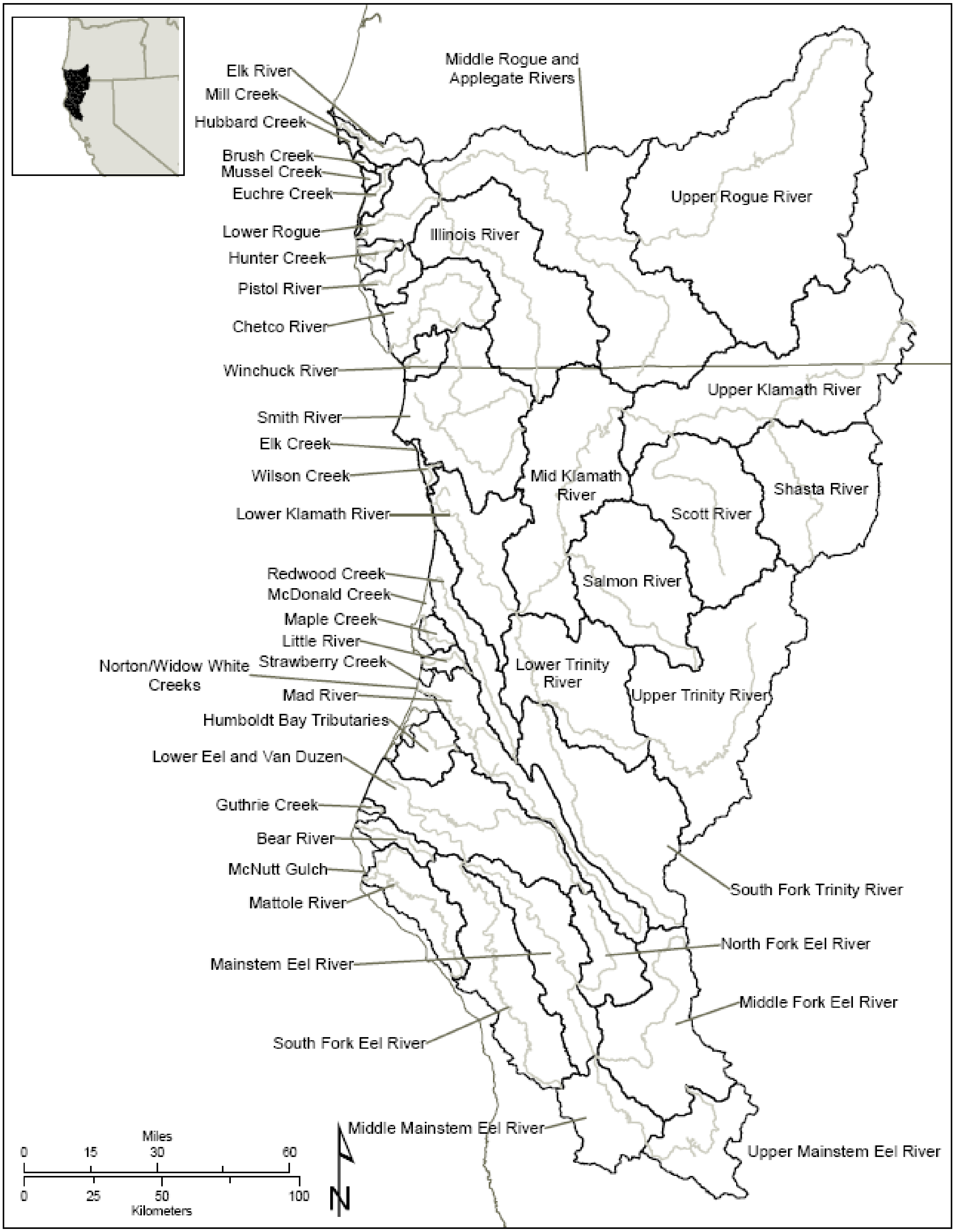


Figure 4. Historic population structure of the SONCC coho salmon ESU from Williams *et al*. (2006). Population types (*i.e.*, Functionally Independent, Potentially Independent, Dependent and Ephemeral populations) are listed in Table 1.

Table 1. Arrangement of historical populations of the Southern Oregon/Northern California Coasts coho salmon ESU from Williams *et al.* 2006. Functionally Independent populations are listed in bold font, Potentially Independent populations are listed in bold italic font, other listed populations are Dependent populations.

Interior sub-basins		**Coastal basins and sub-basins**	
	Population		**Population**
Rogue River Basin	**Illinois River**	**Northern Coastal basins**	**Elk River**
	Middle Rogue / Applegate rivers		Mill Creek
	Upper Rogue River		Hubbard Creek[a]
Klamath River Basin	***Middle Klamath River***		Brush Creek
	Upper Klamath River		Mussel Creek
	Salmon River		Euchre Creek[a]
	Scott River		***Lower Rogue River***
	Shasta River		Hunter Creek
	Lower Trinity River		Pistol River
	Upper Trinity River		**Chetco River**
	South Fork Trinity River		***Winchuck River***
Eel River Basin	**South Fork Eel River**	**Central Coastal Basins**	**Smith River**
	Mainstem Eel River		Elk Creek
	Middle Mainstem Eel River		Wilson Creek
	Upper Mainstem Eel River		**Lower Klamath River**
	North Fork Eel River		**Redwood Creek**
	Middle Fork Eel River		***McDonald Creek***
			Maple Creek / Big Lagoon
			Little River
			Strawberry Creek
			Norton / Widow White Creek
			Mad River
		Southern Coastal Basins	**Humboldt Bay tributaries**
			Lower Eel / Van Duzen rivers
			Guthrie Creek
			Bear River
			McNutt Gulch
			Mattole River

[a] – Hubbard and Euchre creeks are considered ephemeral populations.

IV. THREATS ASSESSMENT

Section 4(a)(1) of the ESA, and NMFS' implementing regulations (50 CFR part 424) set forth procedures for listing species. The Secretary of Commerce must determine, through the regulatory process, if a species is endangered or threatened because of any one or a combination of the following factors: (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) over utilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) inadequacy of existing regulatory mechanisms; or (E) other natural or anthropogenic factors affecting its continued existence. For the SONCC coho salmon ESU, the factors threatening naturally-reproducing coho populations are numerous and varied. Because of its anadromous life history, all life stages of SONCC coho salmon are exposed to threats in multiple habitats (Table 2).

Table 2. Habitats occupied by various life history stages of coho salmon.

Habitat	**Life History Stage Occurrence**				
	Egg	Fry	Juvenile	Smolt	Adult
Freshwater	X	X	X	X	X
Estuarine		X	X	X	X
Marine				X	X

The following discussion summarizes findings regarding the principal factors for decline across the range of the SONCC coho salmon ESU and ongoing factors limiting recovery. While these factors are treated in general terms, it is important to underscore that impacts from certain factors are more acute on some populations of coho salmon than others within the ESU. These population-specific limiting factors are listed in Appendix A and are from the 2007 Pacific Coastal Salmon Recovery Fund Report to Congress (NMFS 2007). These factors were established at the time of listing (NMFS 1997, 2003, 2005) and have also been recognized in the state of California's coho recovery strategy (CDFG 2004). The limiting factors presented in Appendix A are the results of a qualitative ranking exercise where threats to individual coho salmon populations are listed in relative fashion. The discussion below provides a general overview of the various limiting factors, highlights some of the key issues in the ESU, and discusses some of the principal causes of these limiting factors. Development of the recovery plan will provide more detail on these limiting factors, their sources, irreversibility and expected population responses across the SONCC coho salmon ESU.

A. The Present or Threatened Destruction, Modification, or Curtailment of SONCC Coho Salmon Habitat or Range

Habitat conditions are discussed here in terms of; (1) freshwater habitat conditions and; (2) estuarine and tidally-influenced habitat. Changes in habitat conditions for SONCC coho salmon reflect not only physical alterations such as degradation of habitat quality, but changes in the biological environment such as introduction of exotic species and adverse effects from artificial propagation programs. Changes to habitat are widespread and numerous. Many examples of these are provided below. Additionally, global climate change, discussed further in section E, will have a pervasive influence on the processes that control habitat. Thus, actions that focus on restoring habitat forming processes will require an assessment of the potential effects of changing climate.

1. Altered Freshwater Habitat Conditions. Determining freshwater habitat conditions, and identifying those aspects of the freshwater environment that may be limiting the species' recovery, is a key component of recovery planning efforts. There are two reasons for this. First, periods of poor ocean conditions may exacerbate degraded freshwater conditions (see discussion in following sections). Second, many of the factors for the decline of coho salmon involve human-induced changes to the freshwater environment. To assess the threats to the freshwater phases of coho salmon, we are adapting a planning tool developed by The Nature Conservancy over 30 years ago. The Conservation Action Planning (CAP) workbooks are a series of spreadsheets designed to assess threats to systems of interest. More information on The Nature Conservancy's CAP process may be found at:

http://conserveonline.org/workspaces/cbdgateway/cap/resources

In our adaption of the CAP process, we are structuring the analysis around each of the 46 historic coho salmon populations (Table 1). For each population, we assess current conditions using published data and criteria describing functional habitat conditions. We have developed a set of key ecological attributes that reflect physical (*e.g.*, sediment delivery) and biological *(e.g.*, disease) processes that coho salmon depend on for successful freshwater survival. When one or more of these attributes is impaired, whether due to natural or anthropogenic sources, one or more life history phases is exposed to stress from that process. Stresses, in the form of altered physical or biological processes, are rated as to their severity and scope. For example, coho salmon depend on sediment delivery processes that provide for adequate spawning habitat and formation of other habitat elements for rearing, cover and feeding. When the sediment supply is altered, either through an increase, decrease or change in the timing of delivery, physical changes in habitat conditions occur that may limit the survival or reproduction of exposed individuals. These stresses, described below, will form the basis for the assessment of freshwater threats in the final SONCC coho salmon recovery plan. Once stresses are indentified and ranked, sources of stress are identified so that recovery actions may be developed. The stresses described below provide a general overview of how SONCC coho salmon are affected and one or more examples from across the ESU. These stresses are presented in no particular order or ranking as the severity and scope of each will vary both within and across populations. An additional attribute used in the CAP process, *Disease and Predation*, is considered in section C in order to maintain consistency for with the original listing factors.

a. Loss of Floodplain and Channel Structure. Low gradient floodplain settings often provide key habitat for all life stages of coho salmon. Floodplains provide sites of off-channel habitat – a critical component for winter rearing of juveniles. Channel migration across floodplains creates varied topographic features and recruits riparian vegetation, forming complex habitat. Floodplains may trap and store sediment, buffering the effects on downstream reaches. Loss of floodplain connectivity and function may occur through levee construction, changes in sediment and streamflow regime (resulting in channel incision), removal of riparian vegetation, construction of streamside roads and other development which prohibits channel migration or fills floodplain areas (Figure 5).

Conversion of many lowland areas for agriculture has dramatically altered the form and function of floodplains. Although these areas may remain subject to flooding, they lack the structural elements (*e.g.*, woody debris and overflow channels) that provide habitat. The removal of riparian vegetation and smoothing over of abandoned channels has dramatically altered the form and function of many important low gradient coho salmon reaches throughout the ESU.

Channel structure and function is characterized by a suitable distribution of riffles and functional pools, and adequate amounts and sizes of large woody debris or other channel roughness elements (Figure 6). Collectively these features provide juvenile rearing habitat, spawning habitat and holding areas for adults. Changes in streamflow, sediment inputs and recruitment of large woody debris and other coarse structural elements alter the character of these instream habitat elements.

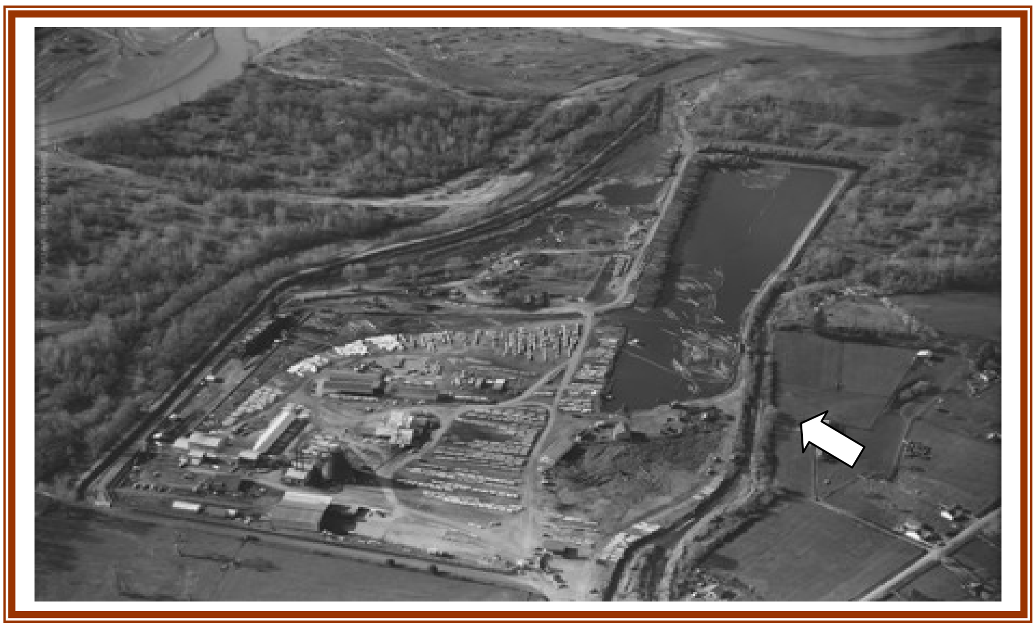


Figure 5. Example of lost floodplain connectivity. This floodplain along a small tributary (right side of photo) to the Mad River was filled for a mill site in the early 1900s. The loss of such periodically inundated areas has not only changed the hydraulic characteristics of the channel but also severely limits the creation of valuable off-channel habitat. Photo from Humboldt State University Library.

Many of the streams throughout the ESU are still experiencing the effects of over a century of widespread timber harvest, road construction, and other land disturbing activities, which have degraded habitat conditions (FEMAT 1993, NMFS 1996, Botkin *et al.* 1997). Ongoing activities such as timber harvest, road construction, water withdrawals, reservoir operations, and streamside agriculture perpetuate this degradation. Loss of instream habitat complexity is a widespread and key limiting factor across nearly all of the coho salmon populations in the ESU (Appendix A). In many cases, recovery of instream habitat will take decades as upstream sediment sources are curtailed, riparian vegetation is re-established, and in-channel sediment is gradually transported out of affected reaches. Recent improvements in forest practices and road standards will likely allow for some recovery of instream conditions, but the magnitude of these effects will likely not be known for decades as legacy conditions subside.

Figure 6. Habitat complexity can be quantified in many ways. In this example from Prairie Creek, large woody debris contributes to pool formation, and sorting of gravels for spawning habitat.

b. Altered Hydrologic Function. Water storage in reservoirs, diversions for agriculture, flood control, domestic, and hydropower purposes have greatly reduced or eliminated historically accessible habitat and degraded remaining habitat (NMFS 1996). The largest rivers in the ESU (*i.e.*, the Rogue, Klamath, Trinity and Eel Rivers) are influenced by reservoirs. Inadequate flow, scouring flows, or changes to the hydrograph can inhibit salmonid development and survival. Agricultural diversions are frequent on many of the inland streams and collective withdrawal rates can result in severe changes in summer and fall stream flows.

Hydrologic processes can also be altered by urbanization, timber harvest and related activities. Harvest and road construction alter runoff patterns by accelerating surface flows from hillsides to stream channels (Chamberlin *et al.* 1991, McIntosh *et al.* 1994). These accelerated flows can increase summer base (low) flows (Keppeler 1998) and increase peak flows during rainstorms (Ziemer 1998). Removal of vegetation reduces evapotranspiration, which can increase the amount of water that infiltrates the soil and ultimately reaches the stream. Conversely, soil compaction caused by heavy equipment can decrease infiltration capabilities, increasing surface runoff. Forest management activities that substantially disturb the soil, such as yarding, burning, or road and skid trail construction, may alter both surface and subsurface pathways that transport water to streams (Thomas *et al.* 1993, Murphy 1995, Keppeler and Brown 1998). Logging can also alter the internal soil structure. As tree roots die, soil "macropores" collapse or are filled in with sediment. These subsurface pathways are important for water transmission. When subsurface flow pathways are destroyed, the flow may be routed to the surface and increase gully erosion and sediment delivery (Keppeler and Brown 1998). Ditches associated with roads collect run-off and intercept subsurface flows, routing them to streams more quickly. Roads act as first order streams and channel more water directly into larger streams (Wemple 1994). Increased peak flows can have direct effects on salmon because the resulting increased stream power can scour stream channels, killing incubating eggs and displacing juvenile salmon from winter cover (McNeil 1964, Tschaplinski and Hartman 1983).

c. Degraded Riparian Forest Conditions. Studies indicate that in most western states, including the area occupied by the SONCC coho salmon ESU, about 80 to 90 percent of the historical riparian habitat has been eliminated (Botkin *et al.* 1995, FEMAT 1993, Norse 1990). This is particularly a problem concerning redwood (*Sequoia sempervirens)*, which takes many decades to decay and could have provided long term benefits to fish habitat and watershed stability. California had lost greater than 85 percent of its coastal redwood forests by 1980 (Wilburn 1985). Similar to instream habitat conditions described above, riparian zones provide key functions for habitat complexity and water quality. The loss, degradation or impairment of riparian conditions has implications for production of food organisms and organic material, shading, bank stabilization by roots, nutrient and chemical mediation, control of surface erosion, and production of large-sized woody material (NMFS 1996). Widespread timber harvest has left a legacy of undersized streamside vegetation. Modern forest practices have lessened the impacts to coho salmon, but NMFS expects the effects of legacy practices will persist for decades as streamside stands gradually attain sufficient size to provide functional large woody debris to adjacent stream channels. Development in lowland areas for agricultural, urban or industrial uses has resulted in a nearly permanent and complete loss of riparian function in many areas. For example, the Bear Creek watershed, tributary to the Rogue River, is one of the more urbanized areas in the ESU. Cumulatively, this development has caused many stresses to coho salmon in the watershed (*e.g.*, altered stream flows, loss of floodplain functions and delivery of urban runoff). However, a principal factor has been narrowed vegetated riparian corridors resulting in elevated water temperatures and loss of habitat quality (Figure 7).

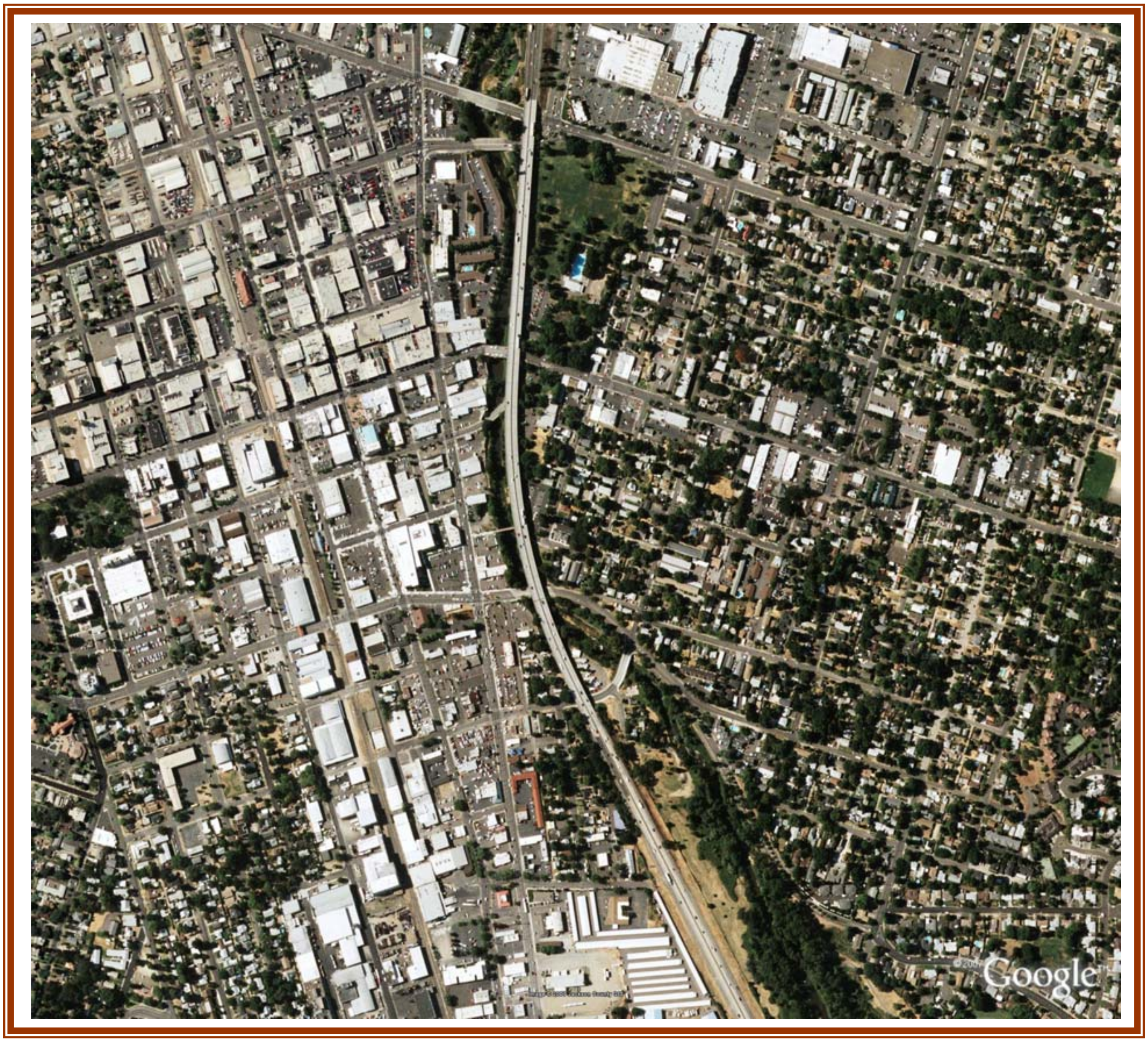


Figure 7. Flowing from bottom to top in the center of the photo, Bear Creek, a large tributary to the Rogue River in southern Oregon, was likely once a key coho stream in the northern inland portion of the ESU, owing to its low gradient, unconfined setting. However, extensive development has imposed numerous stresses to coho salmon habitat, including loss of riparian vegetation, impaired water quality, and loss of floodplain function.

<u>*d. Altered Sediment Supply*</u>. Sedimentation from historic and current extensive and intensive land use activities (*e.g.*, timber harvest, road construction, agriculture, livestock grazing, mining, and urbanization) is recognized as a primary cause of habitat degradation throughout the ESU (CDFG 2004, Oregon Progress Board 2000, NMFS 1996, Botkin *et al*. 1995, Reeves *et al.* 1995, CDFG 1994, FEMAT 1993). Stream substrates provide habitat for spawning, juvenile refuge and food production. Changes in sediment supply, streamflow and instream structural

elements can lead to degradation of streambed characteristics. Attaining desirable sediment conditions will require careful treatment and avoidance of upslope sources, and ensuring adequate streamflows to transport sediment through affected reaches. In many watersheds throughout the ESU, roads are considered to be a significant source of sediment to streams. Addressing roads requires identification of problem sites, appropriate treatments (including removal and/or relocation of the road), careful consideration of new road construction, and appropriate monitoring and maintenance to ensure impacts are minimal.

e. Impaired Water Quality. Water quality may limit coho salmon populations in a number of ways. Coho salmon are sensitive to changes in stream temperature, suspended fine sediment, dissolved oxygen (DO), and nutrients, and the presence of heavy metals, pesticides, herbicides and other contaminants (toxics), even at very low levels. Many of the streams within the ESU are listed as water quality impaired under section 303(d) of the Federal Clean Water Act (Table 2).

For example, in the mainstem Klamath River, poor water quality conditions during the summer have been recognized as a major contributing factor to the decline of anadromous salmonids (Bartholow 1995). The Klamath River mainstem often reaches daytime maximum temperatures over 25°C (Belchik 2003), well above optimal temperatures for juvenile salmonids. Using a weekly mean temperature of 15°C as a threshold for chronic salmonid stress and a daily mean temperature of 20°C as an acute threshold, the 1966-1982 Klamath River temperatures at Orleans exceeded the acute and chronic thresholds a substantial portion of the time (Bartholow 1995).

Throughout the ESU, many stream reaches experience elevated summer water temperatures, resulting in adverse effects to coho salmon. For example, in the middle reaches of Redwood Creek elevated summer water temperatures are unsuitable for juvenile coho rearing – effectively eliminating production from a portion of the watershed (Madej *et al.* 2006). Past removal of riparian vegetation and channel aggradation (widening and shallowing) are the principal contributors to this warming.

Table 2. Clean Water Act, Section 303(d) listed waters in the SONCC coho salmon ESU.

Watershed	Pollutant(s)	Watershed	Pollutant(s)
Eel River Delta	Sediment and Temperature	Redwood Creek	Sediment and Temperature
Middle Fork Eel River	Sediment and Temperature	Salmon River	Nutrients and Temperature
Middle Mainstem Eel River	Sediment and Temperature	Scott River	Sediment and Temperature
North Fork Eel River	Sediment and Temperature	Shasta River	Organic enrichment, Low DO, Temperature
South Fork Eel River	Sediment and Temperature	Trinity River	Sediment
Upper Mainstem Eel River	Sediment and Temperature	South Fork Trinity River	Sediment and Temperature
Elk River	Sediment	Van Duzen River	Sediment
Freshwater Creek	Sediment	Upper Rogue River	Bacteria, DO, pH, Sediment, Temperature
Humboldt Bay	PCBs	Middle Rogue River	Bacteria, Sediment, Temperature
Jacoby Creek	Sediment	Lower Rogue River	Bacteria, Temperature
Klamath River	Nutrients, Temperature, Low Dissolved Oxygen	Illinois River	Temperature
Mad River	Sediment, Turbidity, Temperature	Chetco River	Bacteria, DO, pH, Temperature
Mattole River	Sediment and Temperature	Applegate River	Temperature, DO

f. Migration Barriers. Human-caused blockages eliminate or decrease migration ability or alter the range of conditions under which migration is possible. Dry stream reaches due to changes in streamflow, diversions, or channel aggradation can also present seasonal barriers to migration. Numerous impassable culverts occur throughout the ESU. Many of these barriers preclude access to higher quality headwater reaches, thereby eliminating production from historically productive reaches. Treatment of these sites, although often expensive, yields immediate results as fish are once again allowed access into historically occupied reaches. Counties, the California Department of Transportation and other local entities have been assessing sites to identify and address high priority sites. However numerous sites still exist, particularly on private lands where efforts of local and state agencies have limited accessibility.

Major dams block access to portions of watersheds that historically provided spawning and rearing habitat for coho salmon. Dams on the Rogue, Klamath, Trinity and Eel Rivers block access to large portions of the upper watersheds. Seasonal impoundments for summer water sources may block access to juvenile coho salmon, whether they are outmigrating towards the ocean or moving upstream to seek cooler headwater reaches during the summer and fall months.

g. Adverse Hatchery-related Effects. Extensive hatchery programs have been implemented throughout the range of West Coast salmonids. Hatcheries have numerous ecological, genetic and demographic effects. Ecological effects include predation, competition, and disease transfer/amplification. Genetic effects include reduced diversity within/among populations, domestication selection, and outbreeding depression. Demographic effects occur through broodstock removal, migration delay/blockage, and un-integrated harvest actions (Weitkamp *et al.* 1995, NMFS 1997, NMFS 2003).

NMFS' assessment of the effects of existing artificial propagation programs on the viability of the ESU concluded that they decrease extinction risk by contributing to increased ESU abundance, generally within their respective basins, but have a neutral or uncertain effect on the productivity, spatial structure and diversity of the ESU (NMFS 2003). To reach this proposed determination, NMFS Northwest (NWR) and Southwest Regions (SWR) applied the recently proposed NMFS' Hatchery Listing Policy (69 FR 33102; June 14, 2004) to determine whether SONCC coho salmon hatchery programs contributed to the conservation of SONCC coho salmon populations. Specifically, NMFS evaluated how the hatchery programs affected the VSP parameter risks, related to abundance, productivity, spatial structure and diversity assessed by the BRT for the extant natural-origin populations. NMFS determined there are three artificial propagation programs releasing hatchery coho salmon that are considered part of the SONCC coho salmon ESU. The Rogue River hatchery in Oregon and the Trinity River and Iron Gate hatcheries (Klamath River) in California are all mitigation programs designed to produce fish for harvest, but they integrate naturally produced coho salmon into the brood stock in an attempt to minimize the genetic effects of returning hatchery adults that spawn naturally. All three programs have been in operation for several decades, with smolt production goals ranging from 75,000 to 500,000 fish.

Abundance of the ESU in-total has been increased as a result of these artificial propagation programs, particularly in the Rogue and Trinity Rivers. In the Rogue River, hatchery origin fish have averaged approximately half of the returning spawners over the past 20 years. In the Trinity River, most naturally spawning fish are thought to be of hatchery origin based on weir counts at Willow Creek, and represent roughly 90 percent of the monitored escapement of adults in the Trinity River basin over the past decade.

The long-term impacts of these programs on native, naturally reproducing stocks are not well understood. The state natural resource agencies (Oregon Department of Fish and Wildlife and California Department of Fish and Game) have adopted natural salmonid policies designed to ensure that the use of artificial propagation is conducted in a manner consistent with the conservation and recovery of natural, indigenous anadromous salmonids. While these efforts are encouraging, the careful monitoring and management of current programs, and the scrutiny of proposed programs, is necessary to minimize impacts on listed species as noted by the BRT concerns of high proportions of hatchery fish, especially in the Trinity River.

2. Degraded Estuarine and Tidally-influenced Habitat. Estuarine habitats are naturally dynamic, and provide important rearing (fry, juveniles, smolts) and migratory functions (smolts, adults). The destruction (loss of area) or modification (loss of complexity and connectivity) of estuarine subtidal and intertidal habitats, and associated tidal wetlands has resulted in the loss of important rearing and migration corridor habitat functions (Figure 8). Oregon wetlands are estimated to have diminished by one-third, and over 80 percent of the wetlands in California have been lost (California State Lands Commission 1993). Aside from direct filling of tidal wetlands, loss of habitat function is the result of changes in the habitat forming processes, including (1) alteration of quantity, quality distribution and timing of freshwater inflows; (2) alteration of tidal flows, wave energy, and circulation patterns; and (3) alteration of amount, delivery, and transport of riverine and ocean-derived sediment.

Within the tidally influenced habitats in the SONCC coho salmon ESU, the loss of habitat function is principally related to both legacy and ongoing effects of human activities. These activities (1) maintain agricultural, urban, commercial, recreational, and residential land use; (2) result in natural resource extraction use; and (3) provide overland and port-related transportation links to move people and materials. Activities include, but are not limited to (1) construction and maintenance of jetties, bulkheads, and rip-rap to dissipate wave energy and control shoreline erosion; (2) construction and maintenance of levees, tidegates, and seawalls to protect urban, residential, and agricultural land from flooding; (3) gravel mining and aquaculture permitted use; (4) construction and maintenance of railroads, roads, bridges, and navigation channels (dredging); and (5) construction and maintenance of commercial or recreational facilities (marinas, docks, piers).

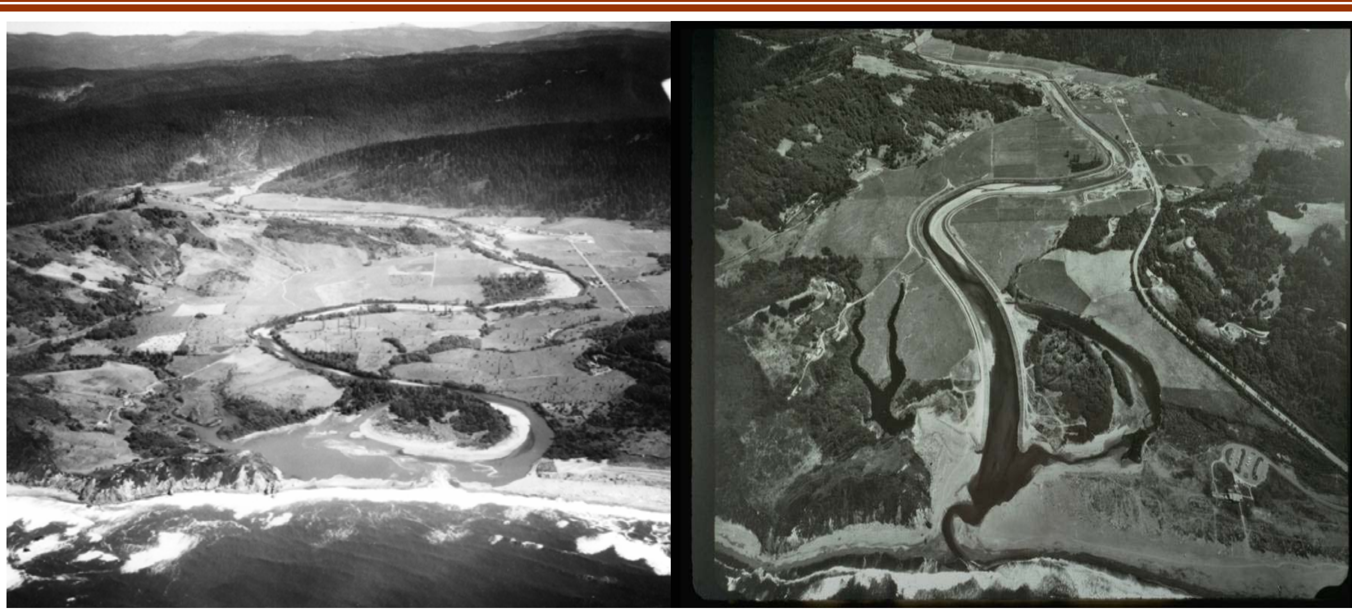


Figure 8. Photos showing the estuary of Redwood Creek near Orick, California, before and after levee construction - resulting in the loss of valuable estuarine habitat. Recent studies indicate that not only do juvenile coho salmon use estuaries prior to ocean entry, but may also use estuarine habitat seasonally during their freshwater rearing phase. Images from KRIS Redwood Creek (krisweb.com).

B. Over Utilization for Commercial, Recreational, Scientific, or Educational Purposes

Historically, coho salmon were abundant in many streams and rivers throughout the SONCC coho salmon ESU. Coho salmon once supported important tribal, commercial and recreational fisheries throughout their range, contributing millions of dollars to numerous local economies, as well as providing important cultural and subsistence needs for Native Americans. Over-fishing in the early days of European settlement depleted many West Coast salmonid stocks, prior to extensive modifications and degradation of freshwater habitats (NMFS 1996, 1997). Even after the degradation of many west coast aquatic and riparian ecosystems, exploitation rates were higher than many populations could sustain. Thus, harvest may be contributing to the further decline of many coho salmon populations (Weitkamp *et al.* 1995).

Determining the impact that past commercial fisheries, and historic and ongoing recreational fisheries had on the decline of salmonids originating from the ESU is difficult. In the early 1900s, canneries at the mouths of large rivers such as the Eel, Klamath and Smith Rivers processed tons of returning adult salmon. As populations declined, these canneries were abandoned, but in-stream sport fisheries continued. During the fall, salmon and steelhead often congregate in the lower rivers awaiting rainfall to proceed upstream, and are vulnerable to angling. In recent years, more restrictive regulations have limited the harvest of salmonids, even requiring the immediate release of all wild salmonids. However, even with more stringent regulations, incidental hooking mortality of listed salmonids continues. The effects of this mortality on individual populations remains poorly understood and needs further assessment.

C. Disease or Predation

Introductions of non-native species and habitat modifications have resulted in increased predator populations in numerous rivers and lakes. This is more of a concern in the larger river basins, such as the Rogue, Trinity, Klamath, and Eel Rivers, where reservoir impoundments alter natural flow regimes and create optimum conditions for the proliferation of non-native, usually warm water species (*e.g.*, bass, sunfish, and other cyprinids) and other non-native species (*e.g.*, hatchery rainbow and brown trout) that escape from the impoundments into the rivers below. Non-native Sacramento pikeminnow (*Ptychocheilus grandis*) are abundant throughout the Eel River basin and are considered to be a serious predator limiting juvenile coho salmon survival (CDFG 2004, NMFS 1996).

Predation by marine mammals (principally seals and sea lions) is also of concern in some small coastal river areas experiencing dwindling Pacific Salmon runs. However, salmonids appear to be a minor component of their diet (Scheffer and Sperry 1931, Jameson and Kenyon 1977, Brown and Mate 1983, Roffe and Mate 1984, Hanson 1993). Predation by marine mammals may significantly influence salmonid abundance in some local populations when other prey species are absent and physical conditions lead to the concentration of salmonid adults and juveniles (NMFS 1996, McEwan and Jackson 1996, CDFG 1994, Brown *et al.* 1994).

Infectious disease is another factor that can influence adult and juvenile coho salmon survival. Salmonids are exposed to numerous bacterial, protozoan, viral, and parasitic organisms in spawning and rearing areas, hatcheries, migratory routes, and the marine environment. Specific diseases such as bacterial kidney disease, ceratomyxosis, columnaris, furunculosis, infectious hematopoietic necrosis virus, redmouth and black spot disease, erythrocytic inclusion body syndrome, and whirling disease, among others, are present and are known to affect West Coast salmonids (Rucker and Ordall 1953, Wood 1979). In general, very little current or historical information exists to quantify changes in infection levels and mortality rates attributable to these diseases for SONCC coho salmon populations. However, studies have shown that naturally spawned fish tend to be less susceptible to pathogens than hatchery-reared fish (Buchanon *et al.* 1983). Native coho salmon populations have co-evolved with specific communities of these organisms, but the widespread use of artificial propagation has introduced pathogens not historically present in a particular watershed. Habitat conditions such as low water flows and high temperatures can exacerbate susceptibility to infectious diseases.

Fish disease is a prime concern in the Klamath River Basin. Researchers suspect low flows and modification of the historic hydrologic regime, combined with poor water quality, have created instream conditions that favor disease proliferation and fish infection. High water temperatures stress adult fish and slow upstream migration rates, facilitating parasite transmission between healthy and sick fish as they congregate in the few cold water refugial areas of the lower Klamath River. Similarly, juvenile infection rates have increased in the past several years as instream habitat conditions suited to the parasites (*Ceratomyxa shasta* and *Parvicapsula minibicornis*) and their intermediate hosts have expanded spatially and temporally as drought and water diversions have altered the natural hydrology of the basin. Investigating the dynamics relating to each parasite's life-cycle and the factors influencing infection rates, combined with thorough monitoring of disease and fish population trends, is critical to implementing restoration measures necessary to return parasite/host populations to more natural levels.

D. Existing Regulatory Mechanisms

NMFS has evaluated the efficacy of many of the existing regulatory mechanisms for protecting anadromous salmonids, as described in proposed listing determinations and supporting reports (69 FR 33102; June 14, 2004) for each ESU. The ESA listing of SONCC coho salmon has provided the incentive for numerous protective efforts. Through these efforts, many causes of decline in coho salmon ESUs are being addressed (*e.g.*, providing fish passage above artificial barriers). Despite Federal and non-Federal efforts, the regulatory mechanisms that exist do not provide sufficient certainty of effectiveness, due to funding and implementation uncertainties and the voluntary nature of many programs. This limitation can be addressed by the recovery planning process, where the activities of various State, Federal and local agencies can be tailored to address key limiting factors for specific populations.

1. Federal Efforts – Clean Water Act (CWA): The Environmental Protection Agency (EPA) and the Army Corps of Engineers (COE) share responsibilities under the CWA. The COE regulates removal/fill activities under section 404 of the CWA, and EPA oversees state and tribal implementation of core programs for providing clean and safe water for the protection of fish, wildlife, and public health.

The CWA is intended to protect beneficial uses, including fishery resources. To date, implementation has not been effective in adequately protecting fishery resources, particularly with respect to point and non-point sources of pollution (*i.e.*, sediment, temperature, nutrients, herbicides and pesticides). Most of the largest basins in the SONCC coho salmon ESU have been designated as impaired, primarily for sediment and water temperature, under the CWA by the EPA in the 1990s (Table 2).

EPA works with State agencies, such as Oregon Department of Environmental Quality, California Department of Water Resources, and Regional Water Quality Control Boards in developing Basin Plans, implementing measures in those plans, and monitoring water quality parameters in meeting plan objectives. Section 303(d)(1) (C) and (D) of the CWA requires States to prepare Total Maximum Daily Loads (TMDLs) for all water bodies that do not meet State or Federal water quality standards (Table 2). TMDLs are a method for quantitatively assessing environmental problems in a watershed and identifying pollution reductions needed to protect drinking water, aquatic life, recreation, and other uses of rivers, lakes, and streams. TMDLs may address all pollution sources including point sources, such as sewage or industrial plant discharges, and non-point discharges such as runoff from roads, farm fields, and forests.

The ability of these TMDLs to protect coho salmon may be significant in the long term; however, it will be difficult to develop, implement, and enforce them quickly due to lack of financial resources. Their efficacy in protecting ESA-listed Pacific Salmon essential habitat will depend on extensive, well coordinated monitoring of those physical and biological attributes of watersheds or species so that information collected can be utilized to assess restoration or recovery efforts and compliance with State and Federal laws and mandates.

2. Federal Efforts – Northwest Forest Plan: This is a coordinated ecosystem management strategy for Federal Lands administered by the U. S. Forest Service and Bureau of Land Management (BLM). ESA section 7 Biological Opinions are in place for all Land and Resource Management Plans (LRMPs), and associated activities under the LRMPs, for all listed species found within each individual National Forest or BLM Resource Area. NMFS has participated in the development and review of watershed analyses across public lands to ensure that restoration actions are consistent with recovery actions for ESA-listed Pacific Salmon. Improved habitat conditions will result in increased survival of the freshwater life stages of these fish. Implementation of actions consistent with the Aquatic Conservation Strategy objectives and components, including watershed analysis, watershed restoration, reserve and refugia land allocations, and associated standards and guidelines, will provide high levels of aquatic ecosystem understanding, protection and restoration. National Forest lands make up the majority of the headwater tributaries for the ESU, accounting for approximately 60% of the total habitat for SONCC coho salmon (Figure 9).

3. Federal Efforts – NMFS Incidental Take Permits for Habitat Conservation Plans:

- *Pacific Lumber Company*. The Pacific Lumber Company Habitat Conservation Plan (PALCO HCP) covers approximately 210,000 acres of industrial timberlands in coastal northern California. The PALCO HCP is habitat based with a defined goal of achieving or trending towards properly functioning aquatic conditions. The PALCO HCP relies heavily on watershed analysis, monitoring, and adaptive management tools to ensure achieving these goals. The major coho salmon populations covered by the HCP include Humboldt Bay, lower Eel and Van Duzen Rivers, and the Mattole River.

- *Humboldt Bay Municipal Water District*. The Humboldt Bay Municipal Water District HCP encompasses activities related to water diversion on the Mad River. As part of the HCP, the District has retrofitted its fish screening facility and established instream flow levels along approximately 60 miles of the mainstem Mad River. Releases from Matthews Dam (Ruth Reservoir) near the headwaters provide valuable, cool water during summer when portions of the mainstem were historically dry.

- *Green Diamond Resource Company*. The Green Diamond Resource Company Habitat Conservation Plan applies to approximately 410,000 acres in coastal northern California. The HCP affects all coastal coho salmon populations from the Oregon border south to, and including, the Eel and Van Duzen Rivers. The HCP provides for removing 50% of high and moderate priority road sites within the first 15 years of plan implementation. These measures, coupled with provisions for riparian protection, mass wasting minimization, and adaptive management, represent an improvement over current state forest practices.

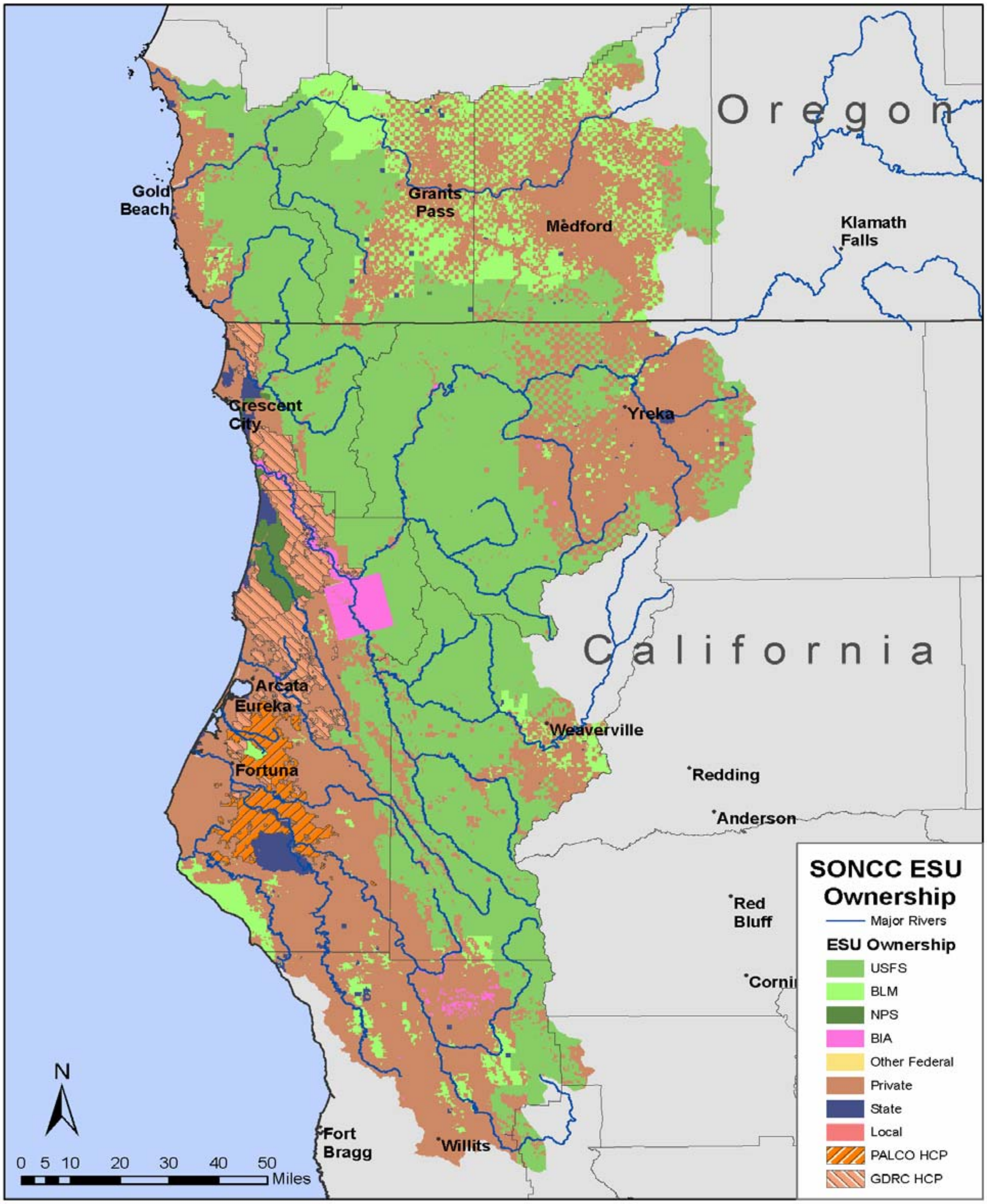


Figure 9. Land ownership across the SONCC ESU. PALCO HCP and GDRC HCP refers to lands managed under the Pacific Lumber Company and Green Diamond Resource Company Habitat Conservation Plans, respectively.

4. State Efforts – Oregon: Oregon's Coastal Salmon Restoration Initiative (OCSRI) was developed in 1996 and implemented in 1997 (OCSRI 1997) under the direction of Oregon's Governor and Legislature when NMFS proposed listing Oregon's coho salmon populations/ESUs. Essential tenets of the OCSRI include:

- The plan comprehensively addresses all factors for decline of Oregon coho salmon, most notably those factors relating to harvest, habitat, and hatchery activities.
- Under this plan, all government agencies whose activities affect salmon are held accountable for coordinating their programs in a manner that conserves and restores the species and their habitat. This is essential because coastal salmon have been affected by the actions of many different state agencies.
- The Plan includes a framework for prioritizing conservation and restoration efforts. Draft coho salmon "core areas" are identified in order to focus measures on retaining current salmon strongholds while rebuilding other areas.
- The Plan includes a comprehensive monitoring component that coordinates Federal, state, and local efforts to improve our understanding of freshwater and marine conditions, determine populations trends, evaluate the effects of artificial propagation, and rate the OCSRI's success in restoring coho salmon.
- The Plan recognizes that actions to conserve and restore salmon must be worked out by communities and landowners--those who possess local knowledge of problems and who have a genuine stake in the outcome. Watershed councils, soil and water conservation districts, and other grassroot efforts are the vehicles for getting this work done.
- The Plan is based upon the principles of adaptive management. Through this process, there is an explicit mechanism for learning from experience, evaluating alternative approaches, and making needed changes in the programs and measures.
- The Plan includes an Independent Multi-disciplinary Science Team whose purpose is to provide an independent audit of the OCSRI's strengths and weaknesses. They will aid the adaptive management process by compiling new information into a yearly review of goals, objectives, and strategies, and by recommending changes to the Plan.
- The Plan requires that a yearly report be made to the Governor, the legislature, and the public.

The protective measures contained in the OCSRI represent commitments by various state agencies (and their stakeholders), watershed councils, the forest industry, and the Federal government to address coho salmon "factors for decline." Factors for decline identified in the OCSRI include:

- loss/degradation of riparian areas
- changes in channel morphology and stream substrate
- loss of in stream roughness
- fish passage impediments
- loss of estuarine rearing habitat
- loss of wetlands
- water quality degradation
- changes in flow
- elimination of habitat
- harvest impacts illegal salmon catch
- salmon by-catch
- low ocean productivity
- loss of genetic adaptation through interbreeding with hatchery fish
- competition with hatchery fish
- predation by pinnipeds and sea birds
- interaction with exotic fish

The OCSRI incorporates measures presented by state agencies and their stakeholders, as well as Federal agencies, to address these factors for decline. However, most of the effort to date has focused on the Oregon Coast coho salmon ESU. NMFS is currently working with the state of Oregon to initiate their Native Fish Conservation process for the southern Oregon portion of the ESU.

5. State Efforts – California: A coho salmon recovery plan was formally approved and adopted by the California Fish and Game Commission on February 5, 2004, and a decision was made to formally list coho salmon under the California ESA effective March 31, 2005. The state has integrated the coho salmon recovery plan with its Fisheries Restoration Grant Program to ensure high priority recovery plan actions in high priority watersheds receive a greater likelihood of funding. The long-term prospects for plan funding and implementation are uncertain at this time. The voluntary nature of all recommendations contained in the plan does not give any assurance that measures to address the limiting factors will be implemented.

The North Coast Regional Water Quality Control Board is in the process of updating its north coast basin plan, which will establish water quality standards for all northern California rivers and streams. These plans will also incorporate newly developed Total Maximum Daily Load standards that are being developed for those water bodies listed as 303(d) impaired under the Clean Water Act. These plans will likely help reduce human impacts to the aquatic environments and may eventually help protect and restore essential habitat for coho salmon.

The California Department of Forestry and Fire Protection enforces State of California Forest Practice Rules (FPRs) promulgated by a governor-appointed Board of Forestry (BOF). Because of the preponderance of private timber land and timber harvest activity in the SONCC coho salmon ESU, careful consideration of the FPRs is necessary. In 1998 NMFS and the State of California entered into a Memorandum of Agreement (MOA), a key part of which was review and revision (if necessary) of the FPRs. In 1999, an independent review panel found, and presented to the BOF, findings that FPRs, including implementation through the timber review process, do not ensure protection of anadromous salmonid habitats and populations. To address these shortcomings, and as specified in the MOA, the California Resources Agency and CalEPA jointly presented the BOF with a proposed rule package in July 1999. Following several months of public review, the BOF took no action on the package in October 1999, thereby precluding any possibility of implementing improvements in California's FPRs by January 1, 2000, as the State committed to do in the MOA. The California State Legislature, gave special authority to the BOF to adopt new rules twice during the year 2000 for the specific purpose of revising the State's FPRs to meet ESA requirements for salmonids. On March 14, 2000 the BOF adopted only a subset of rule changes. Full implementation of these provisions is critically important.

6. Local Agencies: Five-Counties Road Plan NMFS has cooperatively developed a Memorandum of Understanding with five northern California counties (Siskiyou, Trinity, Del Norte, Humboldt and Mendocino), developing a standardized county routine road maintenance manual to help protect ESA-listed species and their habitat. NMFS has also provided over $750,000 in grants to support this program and has worked with the counties in developing a prioritization process to inventory and rank all fish barriers in anadromous waters associated with county roads. Activities to date have restored fish passage to hundreds of miles of habitat and prevented delivery of thousands of cubic yards of sediment to streams.

7. Local Agencies: Oregon Watershed Councils. Numerous watershed groups across southern Oregon have conducted watershed assessments and identified key issues that affect coho salmon recovery in these watersheds. For example, the Bear Creek Watershed Council (Rogue River tributary) is developing restorative, enhancement, and rehabilitative actions targeted at limiting factors. Similarly, several assessments have been completed for the Oregon coast in coordination with the Oregon Watershed Enhancement Board. These assessments will provide critical information for our recovery planning efforts as well as provide guidance to local entities. Many of these assessments are available online at http://www.oregonwatersheds.org/ and http://currywatersheds.org/.

E. Other Natural or Anthropogenic Factors Affecting the Continued Existence of the ESU

Variability in ocean productivity has been shown to affect salmon production both positively and negatively. Beamish and Bouillion (1993) showed a strong correlation between North Pacific salmon production and marine environmental factors from 1925 to 1989. Beamish *et al.* (1997) noted decadal-scale changes in the production of Fraser River sockeye salmon that they attributed to changes in the productivity of the marine environment. They also reported the dramatic change in marine conditions occurring in 1976-77 (an El Niño year), when an oceanic warming trend began. These El Niño conditions, which occur every 3 to 5 years, negatively affect ocean productivity. Johnson (1988) noted increased adult mortality and decreased average size for Oregon Chinook salmon and coho salmon during the strong 1982-83 El Niño. Of greatest importance is not how salmonids perform during periods of high marine survival, but how prolonged periods of poor marine survival affect population viability. Salmon populations have persisted over time, under pristine habitat conditions, through many such cycles in the past. It is less certain how they will fare in periods of poor ocean survival when their freshwater, estuary, and nearshore marine habitats are degraded (Good *et al.* 2005).

The acceptance of global warming as a scientifically valid and anthropogenically-driven phenomenon has been well established by the United Nations Framework Convention on Climate Change, the Intergovernmental Panel on Climate Change, and others. Changes in the distribution and abundance of a wide array of biota confirm a warming trend is in progress, and that it has great potential to affect species' survival (Schneider and Root 2002). In general, as the magnitude of climate fluctuations increases, the population extinction rate also increases (Good *et al.* 2005). Global warming is likely to manifest itself differently in different regions. For example, in California, the overall amount of precipitation may increase but will also be coupled with an increase in critically dry years, which suggests that storms may become more intense (Cayan *et al.* 2006). Many of the threats to the species described above are related to poor streamflow conditions, elevated water temperatures and excessive sediment. Changes in the precipitation regime would be expected to alter these processes and potentially increase extinction risks to salmonids across their range.

V. PRELIMINARY RECOVERY STRATEGY

The preliminary recovery strategy describes initial decisions that have been made about how to recover the species. First, a Priority Number was determined for the species to rank its priority for recovery plan development and implementation. Next, a Recovery Vision Statement was developed to define the overall goal of recovery. Priority tasks were then developed which, if implemented, would improve the species' potential for recovery. Finally, a preliminary action plan for NMFS was written. This plan outlines potential coordination efforts between divisions within NMFS and with other entities involved in salmonid management and recovery. This is a starting point from which the full recovery strategy for the species will be developed.

Recovery Priority Number 1 is given for the SONCC coho salmon ESU, based on a high magnitude of threat, a high potential for recovery, and anticipated conflict with current and future land use and water-associated development within the ESU. The BRT conducting an updated status review in 2004 stated that the SONCC coho salmon ESU is "likely to become endangered within the foreseeable future." This determination was made based on substantially low abundance from historical levels, as coho salmon populations occupy roughly 50 percent of their historic range. Long-term abundance trends are clearly down but stable on the Oregon side of the ESU, and there is concern for many lost coho salmon populations within the larger river basins – namely the Rogue, Klamath, and Trinity Rivers. Strong risks to the abundance, productivity, spatial structure, and diversity of this ESU have largely persisted since its status was first reviewed, and the magnitude of threat for this ESU is high. The recovery potential for this ESU has also been classified as high. Although numerous factors limit the recovery of this ESU, the source of these factors and their demographic impacts are generally known. What is required is an assessment and prioritization of these threats. Although it may be cost-prohibitive to completely address every limiting factor, it is likely that a targeted reduction of specific threats can achieve recovery of this ESU.

A. Recovery Vision Statement.

The threatened SONCC coho salmon ESU has a sufficient number of viable populations within each of the six major population groups to conserve the natural diversity, spatial distribution, and redundancy of populations, and thus, the long term viability of the ESU. Activities have been coordinated within and among the various populations. Monitoring of long term trends in viability parameters and status of threats is on-going and is showing stable populations with upwards trends.

The public has been informed sufficiently to have a good grasp on requirements of the species and its role in the ecosystem. Cooperative relationships exist between private landowners, special districts and local governments with direct control over non-Federal land-use practices. This includes participation in the land use, planning and regulatory processes of the various agencies; and, partnering with various entities to achieve the goals developed in the recovery plan.

B. Priority Tasks to Improve Potential for Recovery.

Priority conservation actions which would improve the species' potential for recovery have been identified for the SONCC coho salmon ESU. These are listed according to the major stresses to coho salmon populations that were discussed previously. As part of the final recovery plan for SONCC coho salmon, a threats assessment will be completed that provides detail on population-specific threats and priority measures that should be taken to restore viable populations. This threats assessment will provide detail at a finer scale than is provided here. Activities listed below are general guidelines, based on the original factors for listing, documented threats that are widespread, and anticipated future activities that could further reduce the viability of existing populations. These include, but are not limited to:

- Degraded Estuarine and Tidally-influenced Habitat.
    - Identify and re-connect historic shallow water habitat.
    - Upgrade tide gates to allow for passage of juveniles and adults.

- Loss of Floodplain and Channel Structure.
    - Identify historically important spawning and rearing reaches and re-establish floodplains in areas that have been filled, diked or diverted.
    - Ensure that future development maintains or enhances existing floodplains.
    - Ensure that activities within floodplains are compatible with achieving long term habitat functions.
    - Ensure that streamside development and land use is compatible with long term habitat improvement in critical stream reaches.
    - Identify critically impaired channel reaches for potential in-stream restoration.

- Altered Hydrologic Function.
    - Balance water supply and allocation with needs and priorities for fish recovery through water rights programs, identification and designation of fully appropriated watersheds, development of passive diversion devices and/or offstream storage, and elimination of illegal water diversions.
    - Review criteria for water storage and dam operations.

- Degraded Riparian Forest Conditions.
    - Ensure that near-stream land uses are compatible with achieving functional riparian zones along streams.
    - Identify critical stream reaches for protection from streamside development.
    - Identify key stream reaches in areas where agricultural activities have removed or severely altered the riparian zone.

- Altered Sediment Supply.
    - Continue efforts to identify priority roads for treatment and/or removal to reduce sediment inputs to streams.
    - Conduct watershed-scale sediment source inventories in areas where sediment is a known stress to coho salmon and target highest priority inputs for treatment.
    - Ensure that ground disturbing activities likely to generate and deliver sediment adhere to appropriate mitigation measures and seasonal restrictions.

- Impaired Water Quality.
    - Restore forest canopy to temperature impaired reaches.
    - Improve/modify reservoir operations to improve downstream water quality.
    - Identify and treat biological and chemical perturbations to 303(d) listed streams through full implementation of the CWA.

- Migration Barriers.
    - Continue to identify barriers to fish passage and provide for unimpeded access for both juveniles and adults.

- Hatcheries
    - Continue to implement research and monitoring to better understand the effects of specific hatcheries on naturally-producing populations. Specifically, the extent and effect of inter- and intra-specific competition between naturally produced and hatchery reared fish should be investigated on the Rogue, Klamath and Trinity populations.

- Disease/Predation/Competition
    - Continue to implement research and monitoring to better understand the effects of disease on Klamath River coho salmon populations.

- Harvest-related adverse effects
    - Conduct further investigation on the role of ocean fisheries on abundance and productivity of coho salmon populations including life-cycle modeling and hooking mortality studies.

- Monitoring.
    - Improve research and monitoring on coho distribution, status and trends.
    - Improve life-stage-specific survival monitoring to better understand the effects of specific threats on the recovery of individual coho salmon populations.

- Outreach and Education.
    - Hold public outreach workshops to solicit additional information on threats to coho salmon populations and needed activities to abate identified threats.
    - Educate water users (*e.g.*, agricultural users, municipalities and residential users) on coho salmon biology and priority actions.
    - Utilize ESA section 7(a)(1) consultation obligations to educate action agencies and project proponents on the recovery needs of coho salmon.
    - Collaborate with interested public, state and Federal resource agencies, local agencies and special interest groups to identify and cooperatively implement priority recovery actions.
    - Encourage continued enforcement of existing rules and regulations.
    - Collaborate with local agencies (*e.g.*, city and county governments) regarding zoning and land use planning efforts to address existing threats and reduce the likelihood of new threats emerging.

VI. PREPLANNING DECISIONS

A single species recovery plan will be prepared for the SONCC coho salmon ESU. NMFS, SWR Protected Resources Division, has initiated the preparation of a draft recovery plan using the most recent recovery planning guidance from NMFS (2006), TRT technical reports, data on species threats and other pertinent information. A draft recovery plan is expected to be released in the fall of 2008. Staff at the NMFS Arcata Area office are the lead preparers of the document. Central to the success of the recovery plan is outreach to Federal, State and local partners. This includes continued collaboration with the state of Oregon as they develop their conservation strategy for coho salmon in southern Oregon. This will occur through public workshops, as well as soliciting review and comments on draft documents. The administrative record will be housed in the Arcata office.

A. Tasks and Schedule for Recovery Plan Development

1) Complete CAP workbook process to identify population-specific threats for the freshwater environment. Circulate for review and comment among agency co-managers and knowledgeable members of the public. *In progress - Fall 2007.*
2) Complete an assessment of estuarine conditions across the SONCC coho salmon ESU. This estuary assessment will follow a similar process as the freshwater assessment in identifying key stresses and sources of stresses. *In progress - Fall 2007.*
3) Compile marine threats assessment information. *In progress - Fall 2007.*
4) Continue to collaborate with Oregon Department of Fish and Wildlife in their Native Fish Conservation Planning efforts. Integrate the information generated from their multi-panel process into the Federal recovery planning process. *Winter 2007/2008.*
5) Synthesize the various threats components (*i.e.*, marine, estuarine, and freshwater) into a final threats assessment for the ESU. As part of this effort, identify uncertainties and data gaps. *Spring 2008.*
6) Using information from the TRT population viability report (*Winter 2007/2008*), and the historic populations report (Williams *et al.* 2006) develop a general framework for determining key populations for conservation and recovery. *Spring 2008.*
7) Using the integrated threats assessment, identify recovery actions and associated costs using economic data currently in preparation by the Southwest Fisheries Science Center. *Summer 2008.*
8) Create a "menu" of recovery options based on ESU viability requirements, costs to implement recovery actions and timelines to achieve desired results. *Summer 2008.*
9) Identify critical research and monitoring needs based on the proposed strategies. *Summer 2008.*
10) Circulate for public review and comment. *Fall 2008.*
11) Complete final recovery plan. *Spring 2009*.

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Appendix A. Limiting factors for SONCC coho salmon populations throughout the ESU. For each of the eleven factors listed, the six most severe limiting factors each are scored a 2 (major limiting factors). The five least limiting factors are scored a 1. The purpose of this table is to provide a coarse overview of the major factors influencing the viability of salmonid populations in the SONCC ESU. From NMFS (2007).

Major Population Group	Population	Degraded Habitat-Estuarine and Nearshore Marine	Degraded Habitat-Floodplain Connectivity and Function	Degraded Habitat-Channel Structure and Complexity	Degraded Habitat-Riparian Areas and LWD Recruitment	Degraded Habitat-Stream Substrate	Degraded Habitat-Stream Flow	Degraded Habitat-Water Quality	Degraded Habitat-Fish Passage	Hatchery-related Adverse Effects	Harvest-related Adverse Effects	Predation/Competition/Disease
Rogue River Basin	**Illinois River**	**1**	**2**	**2**	**2**	**1**	**2**	**2**	**2**	**1**	**1**	**1**
	Middle Rogue / Applegate rivers	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**
	Upper Rogue River	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**2**
Klamath River Basin	***Middle Klamath River***	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**2**
	Upper Klamath River	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**2**

Major Population Group	Population	Degraded Habitat-Estuarine and Nearshore Marine	Degraded Habitat-Floodplain Connectivity and Function	Degraded Habitat-Channel Structure and Complexity	Degraded Habitat-Riparian Areas and LWD Recruitment	Degraded Habitat-Stream Substrate	Degraded Habitat-Stream Flow	Degraded Habitat-Water Quality	Degraded Habitat-Fish Passage	Hatchery-related Adverse Effects	Harvest-related Adverse Effects	Predation/Competition/Disease
	Salmon River	1	1	2	2	2	2	2	2	1	1	1
	Scott River	1	2	2	2	1	2	2	2	1	1	1
	Shasta River	1	2	2	2	2	2	2	1	1	1	1
	Lower Trinity River	1	1	2	2	2	2	2	1	2	1	1
	Upper Trinity River	1	2	2	2	1	2	1	2	2	1	1
	South Fork Trinity River	1	1	2	2	2	2	2	2	1	1	1

Major Population Group	Population	Degraded Habitat-Estuarine and Nearshore Marine	Degraded Habitat-Floodplain Connectivity and Function	Degraded Habitat-Channel Structure and Complexity	Degraded Habitat-Riparian Areas and LWD Recruitment	Degraded Habitat-Stream Substrate	Degraded Habitat-Stream Flow	Degraded Habitat-Water Quality	Degraded Habitat-Fish Passage	Hatchery-related Adverse Effects	Harvest-related Adverse Effects	Predation/Competition/Disease
Eel River Basin	**South Fork Eel River**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**1**	**2**
	Mainstem Eel River	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**2**
	Middle Mainstem Eel River	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**2**
	Upper Mainstem Eel River	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**2**
	North Fork Eel River	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**2**
	Middle Fork Eel River	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**1**	**2**

Major Population Group	Population	Degraded Habitat-Estuarine and Nearshore Marine	Degraded Habitat-Floodplain Connectivity and Function	Degraded Habitat-Channel Structure and Complexity	Degraded Habitat-Riparian Areas and LWD Recruitment	Degraded Habitat-Stream Substrate	Degraded Habitat-Stream Flow	Degraded Habitat-Water Quality	Degraded Habitat-Fish Passage	Hatchery-related Adverse Effects	Harvest-related Adverse Effects	Predation/Competition/Disease
Northern Coastal Basins	**Elk River**	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**1**	**2**	**1**	**1**
	Mill Creek	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**
	Hubbard Creek	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**1**
	Brush Creek	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**1**	**1**	**1**
	Mussel Creek	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**1**	**1**	**1**
	Euchre Creek	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**1**	**1**	**1**
	Lower Rogue River	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**
	Hunter Creek	**1**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**1**	**1**

Major Population Group	Population	Degraded Habitat-Estuarine and Nearshore Marine	Degraded Habitat-Floodplain Connectivity and Function	Degraded Habitat-Channel Structure and Complexity	Degraded Habitat-Riparian Areas and LWD Recruitment	Degraded Habitat-Stream Substrate	Degraded Habitat-Stream Flow	Degraded Habitat-Water Quality	Degraded Habitat-Fish Passage	Hatchery-related Adverse Effects	Harvest-related Adverse Effects	Predation/Competition/Disease
	Pistol River	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**1**
	Chetco River	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**1**	**1**	**1**
	Winchuck River	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**1**	**1**	**1**
Central Coastal Basins	**Smith River**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**1**
	Elk Creek	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**1**
	Wilson Creek	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**1**
	Lower Klamath River	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**2**

Major Population Group	Population	Degraded Habitat-Estuarine and Nearshore Marine	Degraded Habitat-Floodplain Connectivity and Function	Degraded Habitat-Channel Structure and Complexity	Degraded Habitat-Riparian Areas and LWD Recruitment	Degraded Habitat-Stream Substrate	Degraded Habitat-Stream Flow	Degraded Habitat-Water Quality	Degraded Habitat-Fish Passage	Hatchery-related Adverse Effects	Harvest-related Adverse Effects	Predation/Competition/Disease
	Redwood Creek	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**1**
	McDonald Creek	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**
	Maple Creek / Big Lagoon	**1**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**1**	**1**
	Little River	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**1**
	Strawberry Creek	**1**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**1**	**1**
	Norton / Widow White Creek	**1**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**1**	**1**
	Mad River	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**1**

Major Population Group	Population	Degraded Habitat-Estuarine and Nearshore Marine	Degraded Habitat-Floodplain Connectivity and Function	Degraded Habitat-Channel Structure and Complexity	Degraded Habitat-Riparian Areas and LWD Recruitment	Degraded Habitat-Stream Substrate	Degraded Habitat-Stream Flow	Degraded Habitat-Water Quality	Degraded Habitat-Fish Passage	Hatchery-related Adverse Effects	Harvest-related Adverse Effects	Predation/Competition/Disease
Southern Coastal Basins	**Humboldt Bay tributaries**	1	2	2	2	2	2	2	1	1	1	1
	Lower Eel / Van Duzen Rivers	1	2	2	2	2	1	2	1	1	1	2
	Guthrie Creek	2	2	2	2	2	1	2	1	1	1	1
	Bear River	1	2	2	2	2	1	2	2	1	1	1
	McNutt Gulch	1	2	2	2	2	1	2	2	1	1	1
	Mattole River	1	2	2	2	2	2	2	1	1	1	1